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British Isles. It is thought that primitive abundance may be restored to their now exhausted rivers, and not many years hence an acre of water shall be made to produce as much food for man as an acre of land. In America many persons have engaged in pisciculture as an experiment, and some attempts have been made to carry it farther; but as nothing has been done on a large scale, no great results have yet been attained.

THE DRAGON-FLY.

PLATE 9.

BY A. S. PACKARD, JR., M. D.

WERE we to select from among the insects a type of all that is savage, relentless, and bloodthirsty, the Dragon-fly would be our choice. From the moment of its birth until its death, usually a twelve-month, it riots in bloodshed and carnage. Living beneath the waters perhaps eleven months of its life, in the larva and pupa states, it is literally a walking pitfall for luckless aquatic insects; but when transformed into a fly, ever on the wing in pursuit of its prey, it throws off all concealment, and reveals the more unblushingly its rapacious character.

Not only does its horrid visage and ferocious bearing frighten children, who call it the "Devil's Darning-needle," but it even distresses older persons, so that its name has become a byword. Could we understand the language of insects, what tales of horror would be revealed! What traditions, sagas, fables, and myths must adorn the annals of animal life regarding this Dragon among insects!

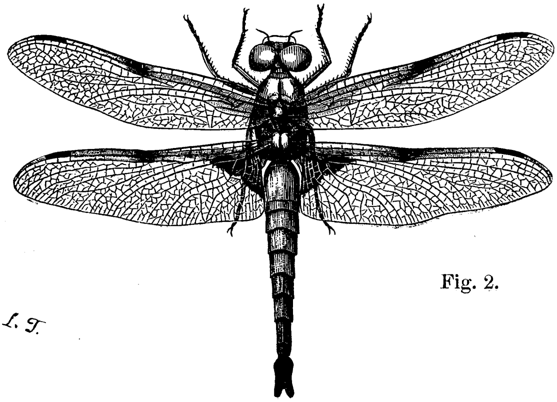


Fig. 2.

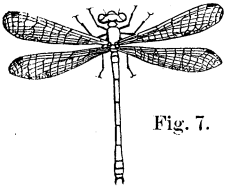


Fig. 7.

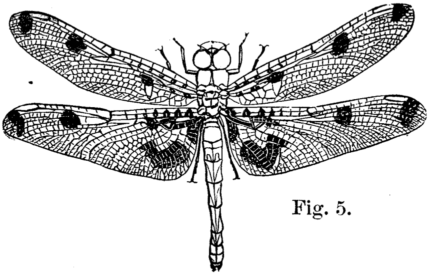


Fig. 5.

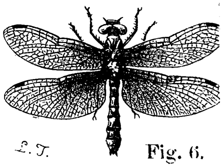


Fig. 6.

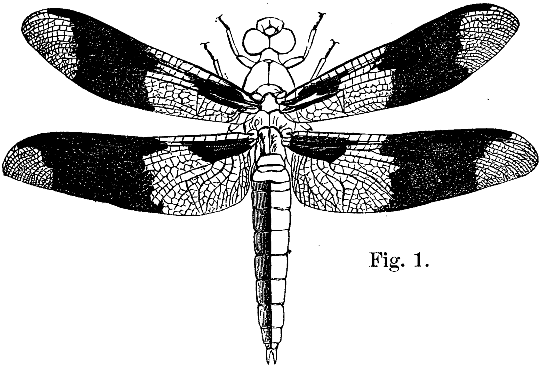


Fig. 1.

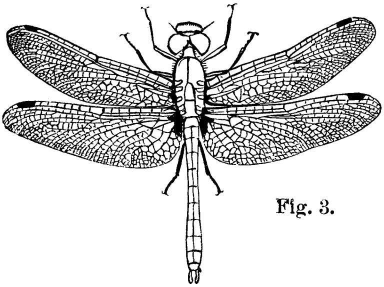


Fig. 3.

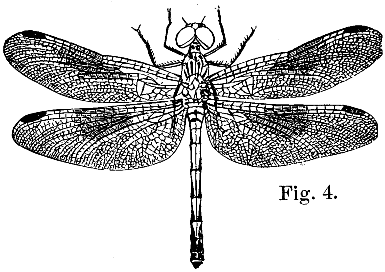


Fig. 4.

PACKARD ON THE DRAGON FLY.

To man, however, aside from its bad name and its repulsive aspect, which its gay trappings do not conceal, its whole life is beneficent. It is a scavenger, being like that class ugly and repulsive, and holding literally, among insects, the lowest rank in society. In the water, it preys upon young musquitoes and the larvæ of other noxious insects. It thus aids in maintaining the balance of life, and cleanses the swamps of miasmata, thus purifying the air we breathe. During its existence of three or four weeks above the waters, its whole life is a continued good to man. It hawks over pools and fields and through gardens, decimating swarms of musquitoes, flies, gnats, and other baneful insects. It is a true Malthus' delight, and, following that sanguinary philosopher, we may believe that our Dragon-fly is an entomological Tamerlane or Napoleon sent into the world by a kind Providence to prevent too close a jostling among the myriads of insect life.

We will, then, conquer our repugnance to its ugly looks and savage mien, and contemplate the hideous monstrosity,—as it is useless to deny that it combines the graces of the Hunchback of Notre Dame and Dickens' Quilp, with certain features of its own,—for the good it does in Nature.

Even among insects, a class replete with forms the very incarnation of ugliness and the perfection of all that is hideous in nature, our Dragon-fly is most conspicuous. Look at its enormous head, with its beetling brows, retreating face, and heavy under jaws,—all eyes and teeth,—and hung so loosely on its short, weak neck, sunk beneath its enormous hunchback,—for it is wofully round-shouldered,—while its long thin legs, shrunken as if from disease, are drawn up beneath its breast, since our fiend of the air is a poor pedestrian.

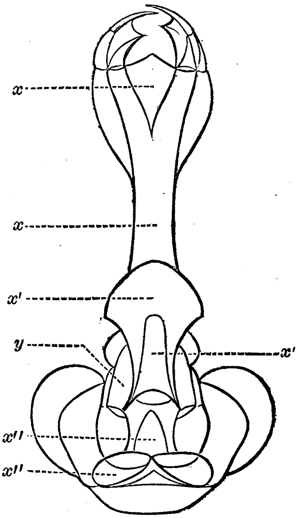
Its gleaming wings are, however, beautiful objects. They form a broad expanse of delicate parchment-like membrane drawn over an intricate network of veins. Though the body is bulky, it is yet light, and easily sustained by the wings. The long tail undoubtedly acts as a rudder to steady its flight.

These insects are almost universally dressed in the gayest colors. The body is variously banded with rich shades of blue, green, and yellow, and the wings give off the most beautiful iridescent and metallic reflections.

During this month, the various species of Libellula and its allies most abound. The eggs are attached loosely in bunches to the stems of rushes and other water-plants. In laying them, the Dragon-fly, according to Mr. P. R. Uhler's observations, "alights upon water-plants, and, pushing the end of her body below the surface of the water, glues a bunch of eggs to the submerged stem or leaf. *Libellula auripennis*, I have often seen laying eggs, and I think I was not deceived in my observation that she dropped a bunch of eggs into the open ditch while balancing herself just a little way above the surface of the water. I have, also, seen her settled upon the reeds in brackish water with her abdomen submerged in part, and there attaching a cluster of eggs. I feel pretty sure that *L. auripennis* does not always deposit the whole of her eggs at one time, as I have seen her attach a cluster of not more than a dozen small yellow eggs. There must be more than one hundred eggs in one of the large bunches. The eggs of some of the Agrions are bright apple-green, but I cannot be sure that I have ever seen them in the very act of oviposition. They have curious habits of settling upon leaves and grass growing in the water, and often allow their abdomens to fall below the surface of the water; sometimes they fly against the surface, but I never saw what I could assert to be the projecting of the eggs from the body upon plants or into the water. The English entomologists assert that the female Agrion goes below the surface to a depth of several inches to deposit eggs upon the submerged stems of plants." The Agrions, however, according to Lucaze Duthiers, a French anatomist, make, with the ovipositor, a little notch in the plant upon which they lay their eggs.

These eggs soon hatch, probably during the heat of summer. The larva is very active in its habits, being provided with six legs, attached to the thorax, on the back of which are the little wing-pads, or rudimentary wings. The large head is provided with enormous eyes, while a pair of simple, minute eyelets (*ocelli*) are placed near the origin of the small bristle-like feelers, or antennæ. Seen from beneath, instead of the formidable array of jaws and accessory organs commonly observed in most carnivorous larvæ, we see nothing but a broad, smooth mask covering the lower part of the face; as if from sheer modesty our young Dragon-fly was endeavoring to conceal a gape. But wait a moment. Some unwary insect comes within striking distance. The battery of jaws is unmasked, and opens upon the victim. This mask (Fig. 1) is peculiar to the young, or larva and pupa

Fig. 1.



Under side of head of *Diplax*, with the labium or mask fully extended. x, x', x'', the three subdivisions of the labium. y, the maxillæ, or second pair of jaws.

of the Dragon-fly. It is the labium, or under lip greatly enlarged, and armed at the broad spoon-shaped extremity (Fig. 1, *x*) with two sharp hooks, adapted for seizing and retaining its prey. At rest, the terminal half is so bent up as to conceal the face, and thus the creature crawls about, to all appearance, the most innocent and lamb-like of insects.

Not only does the immature Dragon-fly walk over the bottom of the pool or stream it inhabits, but it can also leap for a considerable distance, and by a most curious contrivance. By a syringe-like apparatus lodged in the end of the body, it discharges a stream of water for a distance of two or three inches behind it, thus propelling the insect forwards. This apparatus combines the functions of locomotion and respiration. There are, as usual, two breathing pores (*stigmata*) on each side of the thorax. But the process of breathing seems to be mostly carried on in the tail. The tracheæ are here collected in a large mass, sending their branches into folds of membrane lining the end of the alimentary canal, and which act like a piston to force out the water. The entrance to the canal is protected by three to five triangular horny valves (Fig. 2, 9, 10, 2 *a*, side view, 2 *b*), which open and shut at will. When open, the water flows in, bathing the internal gill-like organs, which extract the air from the water. This is then suddenly expelled by a strong muscular effort.

Fig. 2.

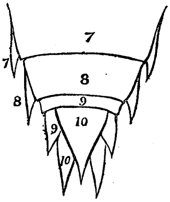


Fig. 2 *a*.

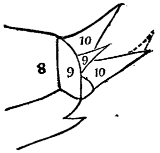
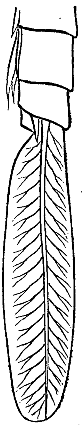


Fig. 2 *b*.



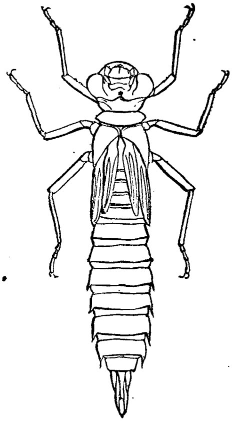
In the smaller genera, *Agrion* (*A. saucium*, Plate 9, fig.

7. Fig. 2 *b*, side view of false-gill, showing but one leaf), *Lestes* and *Calopteryx*, the respiratory leaves, called the tracheary, or false-gills, are not enclosed within the body, but form three broad leaves, permeated by tracheæ, or air-vessels. They are not true gills, however, as the blood is not aerated in them. They only absorb air to supply the tracheæ, which aerate the blood only within the general cavity of the body. These false-gills also act as a rudder to aid the insect in swimming.

It is easy to watch the Dragon-flies through their transformations, as they can easily be kept in aquaria. Little, almost nothing, is known regarding their habits, and any one who can spend the necessary time and patience in rearing them, so as to trace up the different stages from the larva to the adult fly, and describe and figure them accurately, will do good service to science.

Mr. Uhler states that at present we know but little of the young stages of our species, but "the larva and pupa of the *Libellulidæ* may be always known from the *Æschnidæ* by the shorter, deeper, and more robust form, and generally by their thick clothing of hair."

Fig. 3.



Pupa of Æschna.

The pupa scarcely differs from the larva, except in having larger wing-pads (Fig. 3). It is still active, and as much of a gourmand as ever. When the insect is about to assume the pupa state, it moults its skin. The body having outgrown the larva skin, by a strong muscular effort a rent opens along the back of the thorax, and the insect, having fastened its claws into some object at the bottom of the pool, the pupa gradually works its way out of the larva-skin. It is now considerably larger than before. Immediately after this tedious operation, its body is soft, but the crust soon hardens. This change, with most species, probably occurs early in summer.

When about to change into the adult fly, the pupa climbs up some plant near the surface of the water. Again its back yawns wide open, and from the rent our Dragon-fly slowly emerges. For an hour or more, it remains torpid and listless, with its flabby, soft wings remaining motionless. The fluids leave the surface, the crust hardens and dries, rich and varied tints appear, and our Dragon-fly rises into its new world of light and sunshine a gorgeous, but repulsive being. Tennyson thus describes these changes in "The Two Voices":—

> To-day I saw the Dragon-fly
> Come from the wells where he did lie.
> An inner impulse rent the veil
> Of his old husk: from head to tail
> Came out clear plates of sapphire mail.
>
> He dried his wings; like gauze they grew;
> Through crofts and pastures wet with dew
> A living flash of light he flew.

Of our more common, typical forms of Dragon-flies, we figure a few, commonly observed during the summer. *Libellula trimaculata* of Count De Geer, a Swedish entomologist, of which Fig. 1, Plate 9, represents the male, is so-called from the three dark clouds on the wings of the female. But the opposite sex differs in having a dark patch at the front edge of the wings, and a single broad cloud just beyond the middle of the wing.

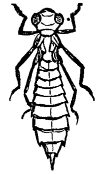
Libellula quadrimaculata (Fig. 2, Plate 9), the four-spotted Dragon-fly, is seen on the wing in June, flying through dry pine woods.

The largest of our Dragon-flies are the "Devil's Darningneedles," *Æschna heros* and *grandis*, seen hawking about our gardens till dusk. They frequently enter houses, carrying dismay and terror among the children. The hind-body is long and cylindrical, and gaily colored with bright green and bluish bands and spots.

Mr. Uhler informs us that the pupa of *Æschna*, figured above, from a drawing by Mr. F. G. Sanborn, is perhaps that of *Æschna constricta*, or *Æ. clepsydra*.

One of our most common Dragon-flies is *Diplax rubicundula*, the ruby Dragon-fly, which is yellowish red. It is seen everywhere flying over pools, and also frequents dry sunny woods and glades. Another common form is *Diplax Berenice* of Drury (Plate 9, Fig. 3 male, Fig. 4 female. The accompanying cut represents the pupa, probably of this species, according to Mr. Uhler.) It is black, the head blue in front, spotted with yellow, while the thorax and abdomen is striped with yellow. There are fewer stripes on the body of the male, which has only four large yellow spots on each side of the abdomen. Still another pretty species is *Diplax Elisa* of Dr. Hagen (Plate 9, Fig. 5). It is black, with the head yellowish and with greenish yellow spots on the sides of the thorax and base of the abdomen. There are three dusky spots on the front edge of each wing, and a large cloud at the base of the hind pair toward the hind angles of the wing.

Fig. 4.



Pupa of *Diplax*.

Rather a rare form, and of much smaller stature is the *Nannophya bella* of Uhler (Fig. 6, female). It was first detected in Baltimore, and we afterwards found it not unfrequently by a pond in Maine. Its abdomen is unusually short, and the reticulations of the wings are large and simple. The female is black, while the male is frosted over with a whitish powder. Many more species of this family are found in this country, and for descriptions of them we would refer the reader to Dr. Hagen's Synopsis of the Neuroptera of North America, published by the Smithsonian Institution.

The Libellulidæ, or family of Dragon-flies, and the Ephemeridæ, or May-flies, one of which is figured in our second number, are the most characteristic of the Neuroptera, or veiny-winged insects. This group is a most interesting one to the systematist, as it is composed of so many heterogeneous forms which it is almost impossible to classify in our rigid and at present necessarily artificial systems. We divide them into families and sub-families, genera and sub-genera, species and varieties, but there is an endless shifting of characters in these groups. The different groups would seem well limited after studying certain forms, when to the systematist's sorrow here comes a creature, perhaps mimicking an ant, or aphis, or other sort of bug, or even a butterfly, and for which they would be readily mistaken by the uninitiated. Bibliographers have gone mad over books that could not be classified. Imagine the despair of an insect-hunter and entomophile, as he sits down to his box of dried neuroptera. He seeks for a true neuropter in the white ant before him, but its very form and habits summons up a swarm of true ants; and then the little wingless book-louse (*Atropos*) scampering irreverently over the musty pages of his *Systema Naturæ*, reminds him of that closest friend of man—*Pediculus vestimenti*. Again, his studies lead him to that gorgeous inhabitant of the Mediterranean shores, the butterfly-like *Ascalaphus*, with its gorgeous wings, and slender, knobbed antennæ so much like those of butterflies, and visions of these beautiful insects fill his mind's eye; or sundry dun-colored caddis flies, modest, delicate neuroptera, with finely fringed wings and slender feelers, create doubts as to whether they are not really allies of the clothes moth, so close is the resemblance.

Thus the student is constantly led astray by the wanton freaks Nature plays, and becomes sceptical as regards the truth of a natural system, though there is one to be discovered; and at last disgusted with the stiff and arbitrary systems of our books,—a disgust we confess most wholesome, if it only lead him into a closer communion with nature. The sooner one leaves those maternal apron-strings,—books,—and learns to identify himself with nature, and thus goes out of himself to affiliate with the spirit of the scene or object before him,—or, in other words, cultivates habits of the closest observation and most patient reflection,—be he painter or poet, philosopher or an insect-hunter of low degree, he will gain an intellectual strength and power of interpreting nature, that is the gift of true genius.

THE LAND SNAILS OF NEW ENGLAND.

BY EDWARD S. MORSE.

(Continued from page 188.)

The snails thus far described represent a natural group having, generally, a stout, heavy shell, and usually a reflected lip to the aperture. The jaw is heavily ribbed, and the teeth are short, and, on the extreme border of the membrane, serrated. The jaw and teeth of *Helix albolabris*, figured in the first number of the Naturalist, represents well like characters of the group. The species now to be considered have smooth or polished shells, the